Illinois Environmental Protection Agency
Division of Land Pollution Control

Preliminary Hydrogeologic Investigation of TCE Contamination Near Roscoe, Winnebago County

by Timothy Greetis

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In March 1982, the Illinois State Water Survey (ISWS) began an extensive study concerning the nitrate level of contamination in the private homes of Roscoe, Hononegah Country Estates and other nearby subdivisions of Northeastern Winnebago County. Prior to the completion of this study, the Winnebago County Department of Public Health randomly sampled wells in the Hononegah Country Estates Subdivision for the possible presence of volatile organic chemicals (VOC's). Several wells were found to contain a total sum of VOC's ranging in levels from traces to greater than 1600 parts per billion (ppb). Most wells were affected by at least three VOC's: trichloroethylene (TCE), 1,1,1-trichloroethane and tetrachloroethylene (PCE). Common solvents and degreasers, these compounds are used in a variety of industrial and commercial processes. Each home in the subdivision, totalling approximately 130, is served by its own water well supply because there is not a Public Water Supply Well in the area.

The Illinois Environmental Protection Agency (IEPA) was contacted by the ISWS to perform and assist the drilling and monitor well installation necessary to fulfill the grant issued by the Illinois Department of Energy and Natural Resources to the ISWS. The purpose of the grant was to evaluate the extent and degree of VOC contamination in the groundwater of the Hononegah Country Estates and Roscoe area. So, in August of 1983, the IEPA and ISWS began a hydrogeologic evaluation and investigation of the Roscoe/Northeastern Winnebago County area.

Method of Study

Prior to drilling and installation of the stainless steel permanent monitor wells, temporary wells were installed at various locations. These were performed on July 19-21, 1983 under the supervision of Allen Wehrmann of the ISWS and were drilled by local drillers volunteering their own services to aid in the investigation of groundwater contamination of the area. Following the collection of a groundwater sample, these wells were removed and the borehole backfilled. Results of the samples collected are reported on a map by Allen Wehrmann which is included in this report. From these analysis, a groundwater monitoring plan was developed and the actual drilling of the permanent monitor wells began on August 8 and concluded on August 11, 1983.

Upon arriving at the drilling location, research was performed on the geology that would be encountered. Due to the homogeneity of the glacial deposits, it was anticipated that thick sands and gravels would be abundant and that sampling by split spoon would be cumbersome, arduous, and time consuming. Therefore, logging of the borehole was performed on the materials brought up by the rotation of the auger. This was only done on the initial boring at each nest as that boring was always the deepest. As seen in the materials brought to the surface, there was no indication of any other lithology but the sands and gravels which were anticipated. Soil classifications indicated on the boring logs are visual classifications and are not the result of laboratory

classification tests. The actual drilling was performed using a hollow-stem auger with the inside plug and bit installed. This procedure was consistently followed until a depth where water was encountered, then the inside plug was removed because it would tend to "cement" itself inside the auger due to the sand grains and removal would be burdensome.

A total of nine (9) monitor wells were installed at four (4) different nested locations. At Nest 1, three monitor wells were installed and at Nests 2, 3, and 4, only two (see Map II for nest locations). Well specifications are located on Table 1a. The well number represents the nest number (e.g., N1) and the total depth of well (e.g., 80). Each well was constructed using 2" stainless steel casing with threaded joints. The casing was steam cleaned and the joints were threaded together using teflon tape. The well screens were 2' screen length with the slotted area being 0.010 size. These screens also included a welded on drive cone. The concrete/bentonite grout used was a mixture of concrete (80#) plus approximately 5 percent bentonite. Through experience and data, this grout was less frequent to cracking and a more impermeable plug/seal was achieved.

Geology

Beneath the study area, a deep valley had been carved by the erosional action of melt waters from the glaciers during their advance

and retreat stages. These melt waters carried abundant amounts of sands and gravels with silts, clays, and some organic matter and deposited them within the valley limits. Sands and gravels comprise the majority of the subsurface deposits in the study area. These deposits are as much as 200 feet thick in the deepest portions within this now buried bedrock valley. Exposed beneath these sands and gravels was the St. Peter Sandstone when the bedrock valley was carved through the Galena-Platteville Dolomite. For the purpose of this investigation, only the deposits within the upper 80 to 85 foot depth will be considered which include only the glacial sands and gravels.

Hydrogeology

The hydrogeology of the area is relatively simplex, due to the homogeneity of the sands and gravels present. Groundwater flow would be in a south-southwesterly direction as seen by water levels recorded in Fall of 1982 during the nitrate study (see Map IV) and present levels in the recently installed monitor wells (see Table 1b). Using Darcy's Equation modified for velocity:

$$V = K \frac{dh}{dl} \frac{1}{n}$$

where:

K = permeability
$\frac{dh}{dl}$ = hydraulic gradient
n = porosity

One would be able to determine the velocity of laminar groundwater flow assuming no additions or withdrawls of water to and/or from the aquifer. So, supposing two conditions -- 1.) the permeability of the sands is equal to 1×10^{-2} cm/sec. and 2.) the porosity of clean sand is equal to 25 percent (from Freeze and Cherry, 1979). Therefore:

$$V = 1 \times 10^{-2} \text{ cm/sec} \times \frac{4.68 \text{ ft}}{2140.5 \text{ ft}} \times \frac{1}{.25}$$

(conversion from cm/sec to ft/yr = cm/sec x 1.03465×10^6)

$$V = (1.0347 \times 10^4)(2.1864 \times 10^{-3})(4)$$
$$V = 90.491 \text{ ft/yr}$$

This provides a velocity of 90.491 feet per year for groundwater movement. This velocity is an estimate under the circumstances stated and does not necessarily represent the actual groundwater flow velocity in the aquifer of the study area.

Groundwater Quality

Initial sampling results collected August 30-31, 1983 of the ISWS/IEPA monitor wells indicate that groundwater contamination of TCE is occurring in the study area.

Well	TCE Concentration (ppb)
N1-80	281
N1-70	460
N1-60	1112
N2-60	293
N2-50	43
N3-55	59
N3-40	267
N4-60	402
N4-50	829

Comparison of these analysis with the temporary well sample analysis might indicate that the source is most likely not continuous. Conclusions are difficult to make at this time since only a very few samples have been collected and comparison of these would not accurately represent the actual increase/decrease of contaminants at a given point. Future sampling of these wells would aid in comparison and conclusions of the groundwater quality in the study area. Furthermore, at this tine, a source of contamination cannot be determined until further investigation and data collection is achieved.

Table 1a
Well Specifications

Well #	Screen Packing	Concrete/Bentonite Grout Plug	Cuttings	Surface Seal
N1-80	80-29	29-27	27-2.5	2.5-0
N1-70	70-31	31-29	29-2.5	2.5-0
N1-60	60-30	30-27	27-2.5	2.5-0
N2-60	60-29	26-24	24-2.3	2.3-0
N2-50	50-25.5	25.5-23.5	23.5-2.5	2.5-0
N3-55	55-26	26-25	25-2	2-0
N3-45	40-7.5	-	7.5-2.5	2.5-0
N4-60	60-25	25-24	24-2	2-0
N4-50	50-25.5	25.5-24	24-2.3	2.3-0

All figures recorded in depth below surface.

Table 1b
GW Elevations of August 30-31, 1983

N1-80	717.34
N1-70	717.41
N1-60	717.40
N2-60	722.08
N2-50	722.07
N3-55	720.88
N3-40	720.87
N4-60	721.89
N4-50	721.91

TG:rd8259C/26-33

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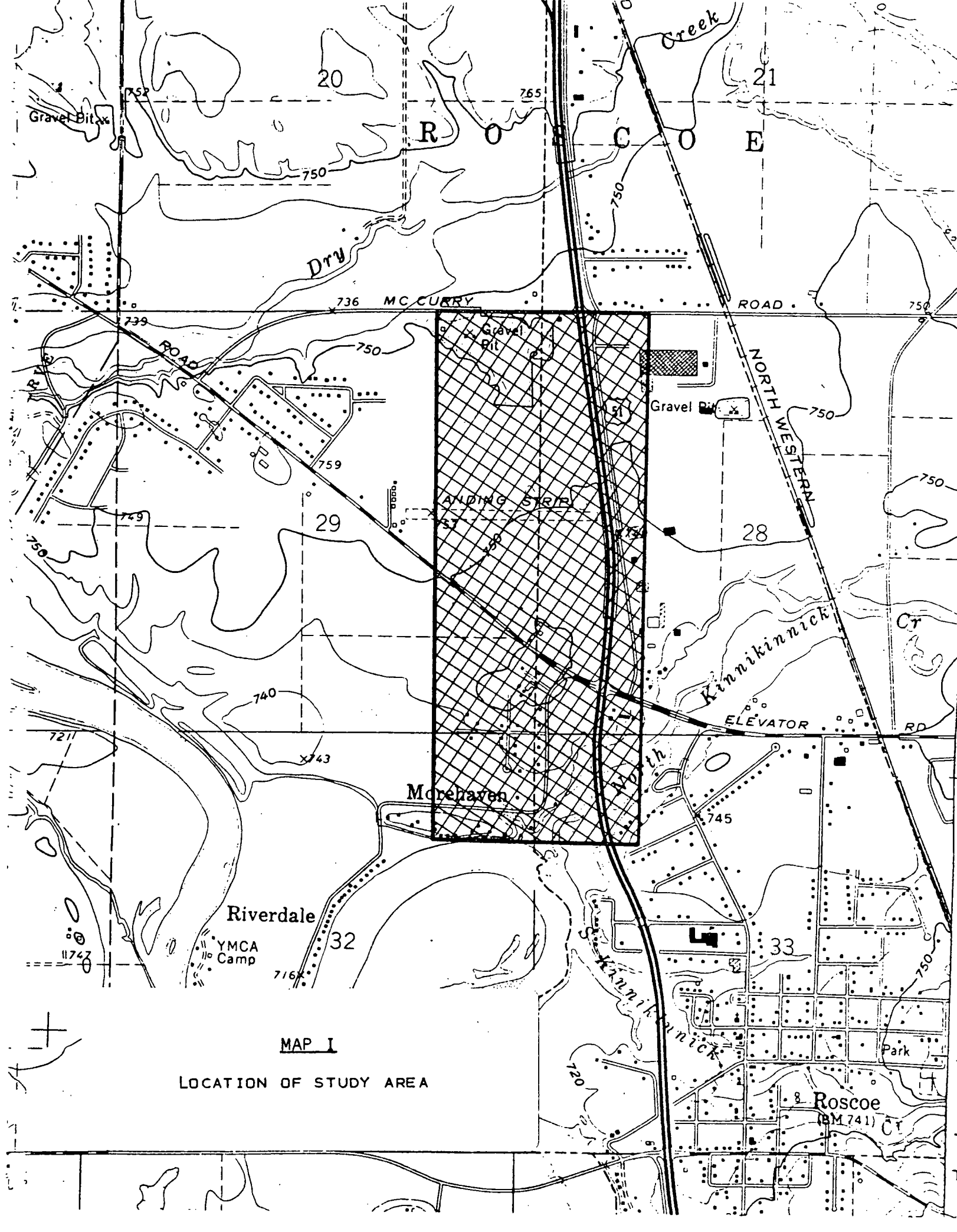
Bouwer, Herman, Groundwater Hydrology. McGraw Hill Book Company (1978) 480 pp

Freeze, R. A. and J. A. Cherry. Groundwater. Prentice-Hall, Inc. (1979) 604 pp

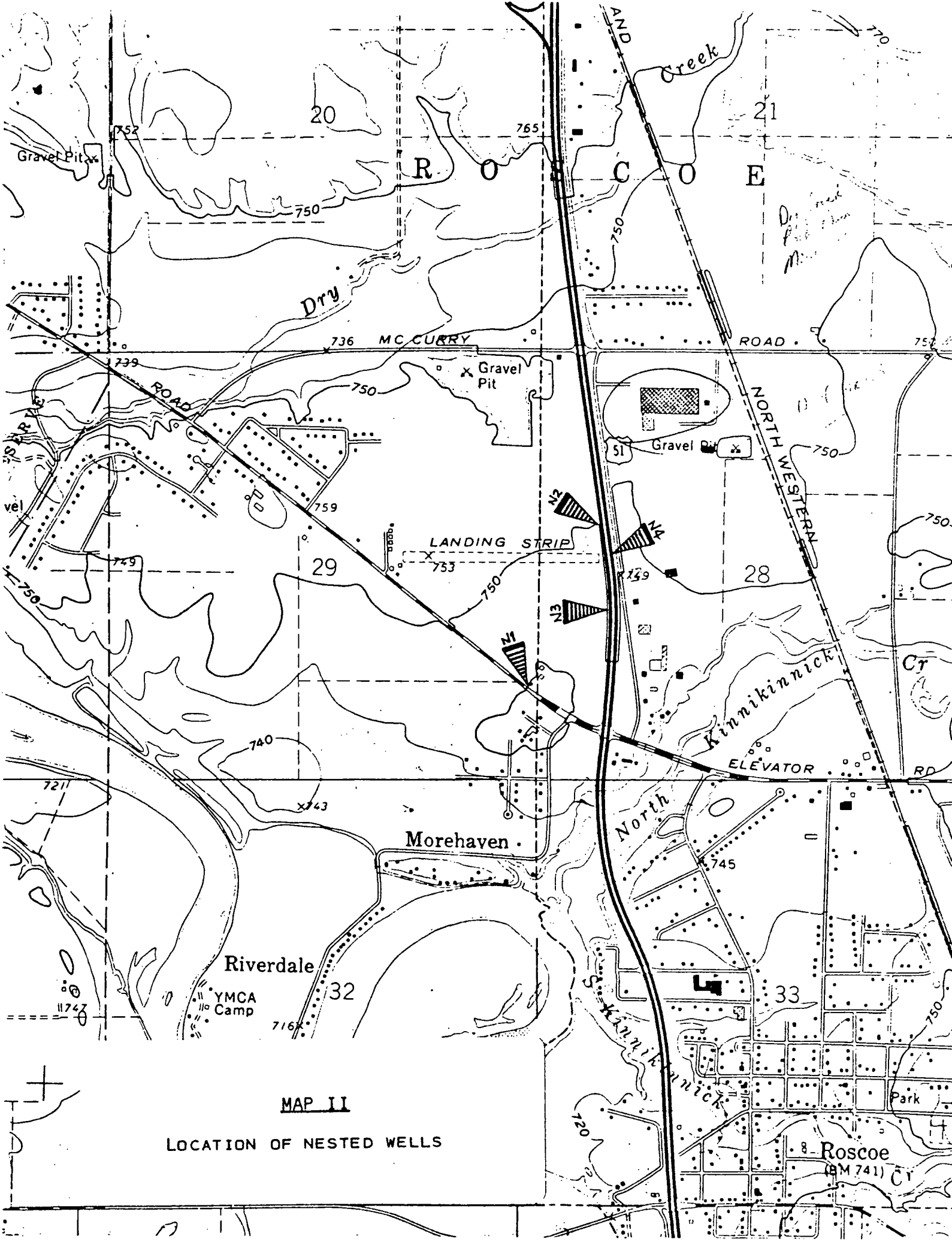
Wehrmann, H. A., Potential Nitrate Contamination of Groundwater in the Roscoe Area, Winnebago County, Illinois, Illinois State Water Survey (1983) 108 pp

BASE MAP - STATE OF ILLINOIS
ALSO WINNEBAGO COUNTY
& CITY OF ROSCOE



MAP I

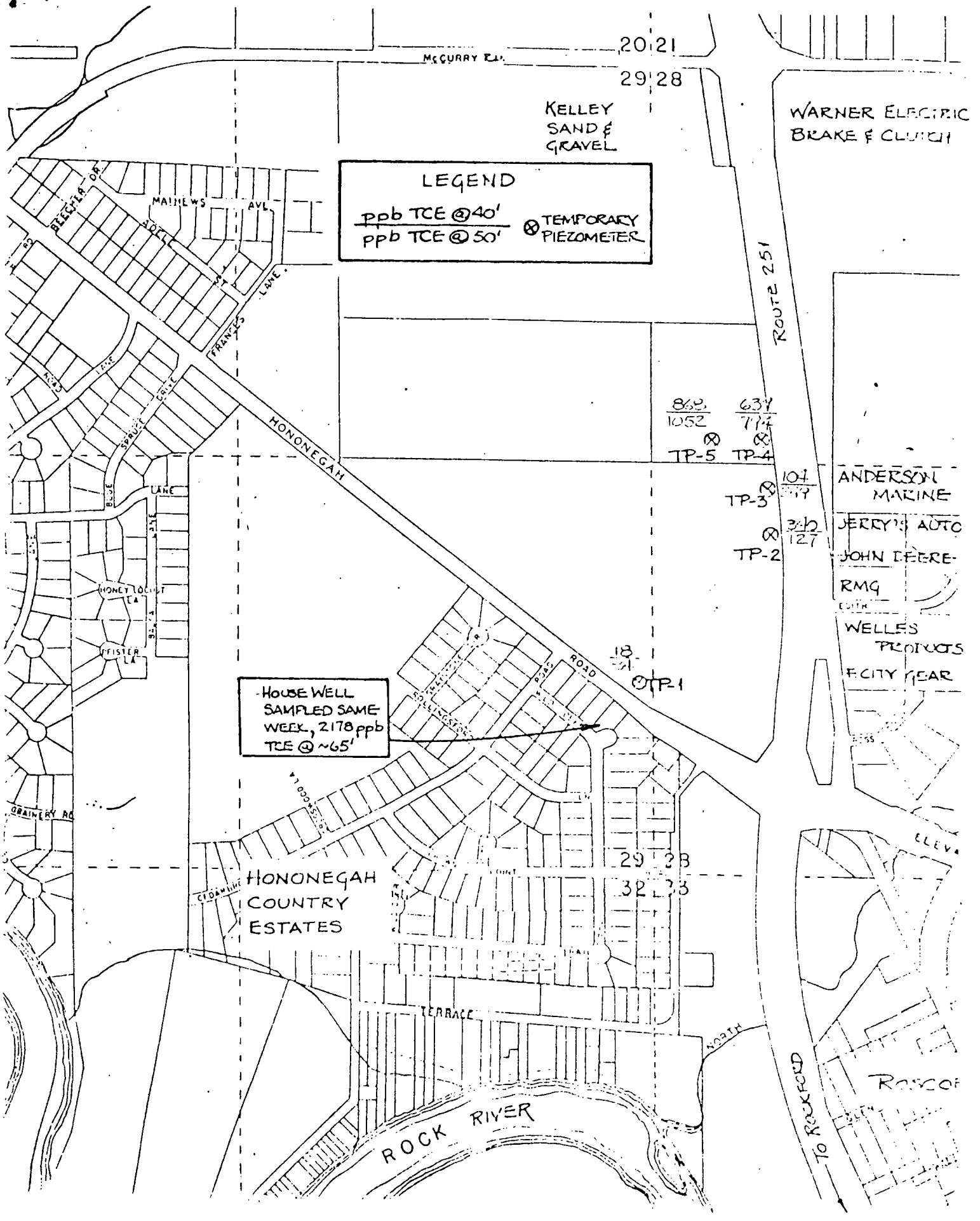
LOCATION OF STUDY AREA

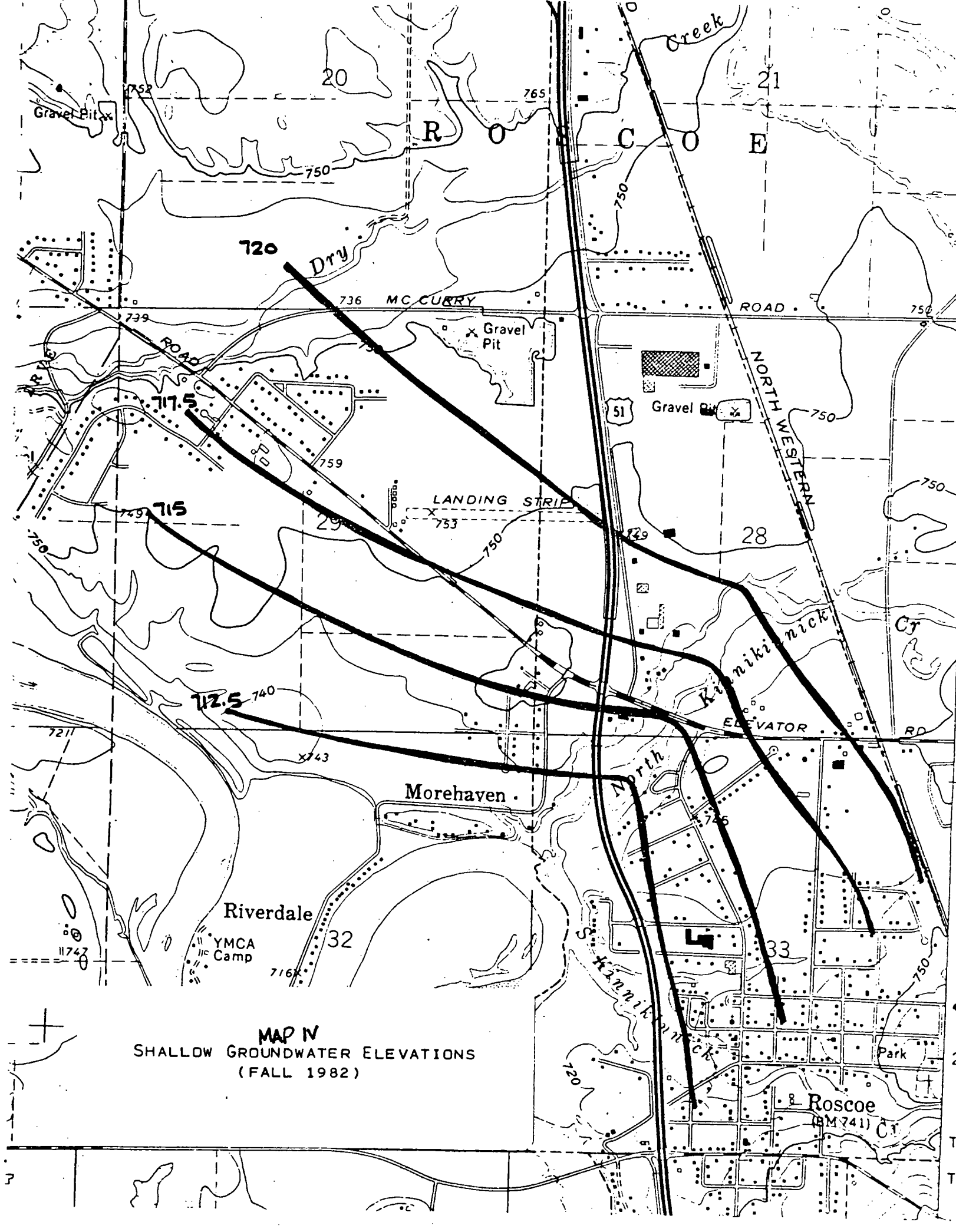


MAP II

LOCATION OF NESTED WELLS

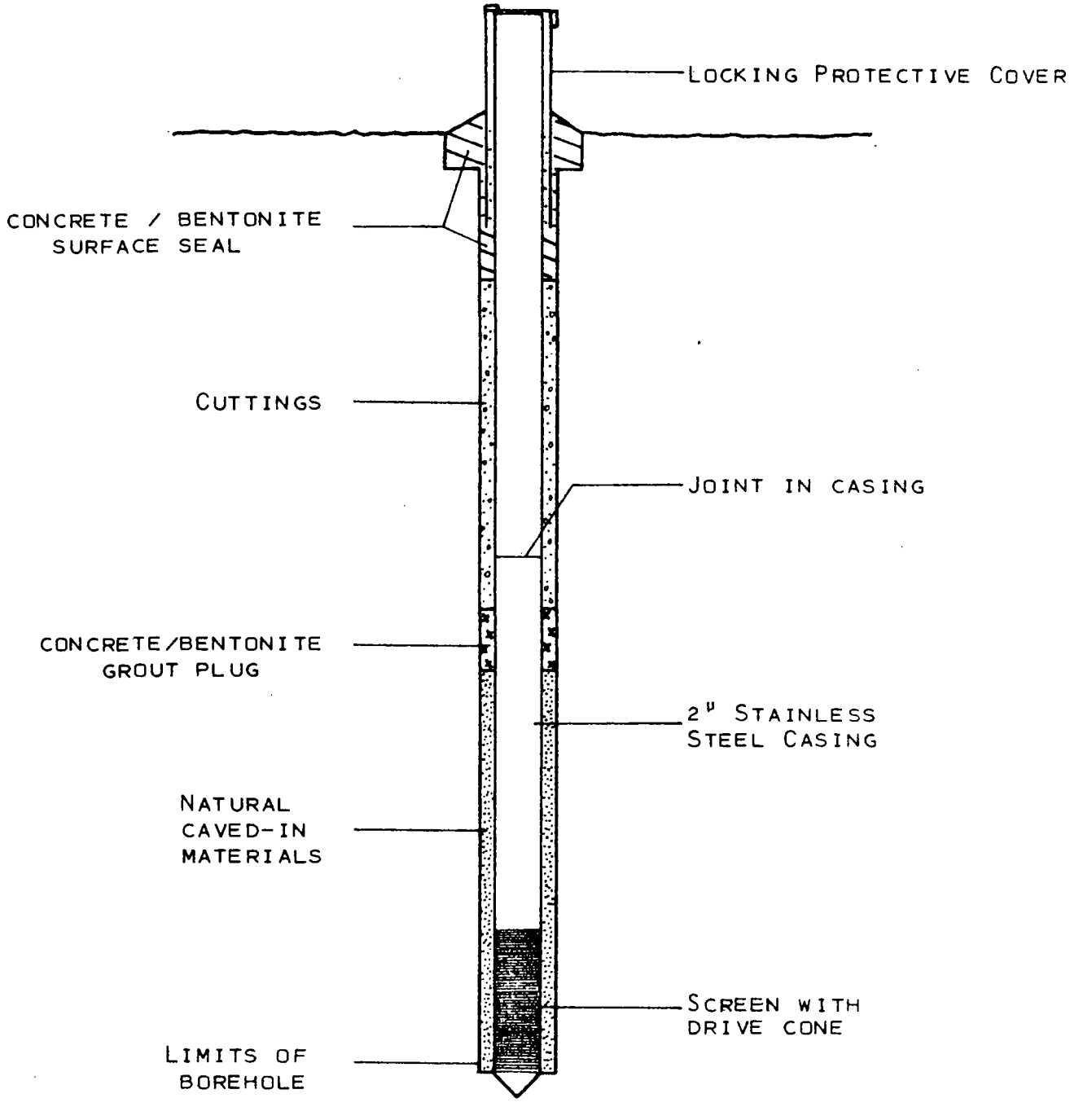
RESULTS OF SAMPLING TEMPORARY WELLS
JULY 19-21, 1983





MAP IV
SHALLOW GROUNDWATER ELEVATIONS
(FALL 1982)

SCHEMATIC DRAWING OF MONITOR WELL



**NOTE-NOT DRAWN TO EXACT SCALE

Illinois Environmental Protection Agency

BORING NO. B1 | WELL NO. N1-80 | GROUNDLEVEL ELEV 750.12 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO:

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE, IL. AREA

BORING LOCATION: ~25' WEST OF OLD FARM ENTRANCE - NORTH SIDE OF HONONEGAH RD.

DRILLING EQUIPMENT: CME 55 | SIZE | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 80.0 | BEDROCK DEPTH: – | TOP OF CASING: 753.16

DATE: START 8/8/83 FINISH 8/9

TIME: START 2:30p - 8/8 FINISH 7:30a; 10:40a - 8/9 - 5:00p

ANNULUS FILL MATERIAL: ABOVE PACKING: CUTTINGS; PACKING: CONCRETE/BENTONITE GROUT; SCREEN: NATURAL MATERIALS

WELL CASING: TYPE AND QUANTITY: (8) 10' SECTIONS OF 2" STAINLESS STEEL SCREW JOINT (TEFLON TAPED JOINTS)

SCREEN INTERVAL: TYPE AND QUANTITY: (1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

PERSONNEL: L. TIM GREETIS; D. DOUG TOLAN; H. STEVE ESTES

ELEV.	DESCRIPTION	DEPTH	SAMPLES: Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)	REMARKS
750.12	Top 2.0' – SILT - brown, topsoil							• NO SAMPLING PERFORMED. – CLASSIFICATION OF MATERIALS BROUGHT UP WITH AUGER.
	SAND & GRAVEL – Medium sand to very coarse gravel	10, 20, 30, 40, 50, 60, 70						
	37.0' SAND - brown, medium to coarse grain sand, angular to sub-rounded, moist.							
670.12		80						BORING COMPLETE

IL 532-1112
LPC 137 6/83

Illinois Environmental Protection Agency

BORING NO. B2 | WELL NO. N1-70 | GROUNDLEVEL ELEV. 750.52 | PAGE 1 OF 1

COUNTY: Winnebago | SITE NO.:

SITE: TCE Groundwater Contamination - Roscoe, IL area

BORING LOCATION: ~5' Northeast of B1 (N1-80)

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: Hollow Stem Auger

COMPLETION DEPTH: 70.0 | BEDROCK DEPTH: - | TOP OF CASING: 753.34

DATE: START 8/10/83 FINISH 8/10

TIME: START 6:45am FINISH 9:30am

ANNULUS FILL MATERIAL: ABOVE PACKING Cuttings | PACKING Concrete/Bentonite Grout | SCREEN Natural Materials

WELL CASING: TYPE AND QUANTITY (7) 10' sections of 2" stainless steel screen joint (Teflon taped joints)

SCREEN INTERVAL: TYPE AND QUANTITY (1) 2' screen plus drive cone + (1) Protective Cover

PERSONNEL: L. T. Greetis | D. D. Tolan | H. S. Estes

ELEV.	DESCRIPTION	DEPTH	Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)	REMARKS
750.52	Augered down to 70.0'	10						*No sampling performed.
	Water encountered at 34.0'	20						
		30 ▼						
		40						
		50						
		60						
680.52		70						Boring Complete

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BORING NO. B3 | WELL NO. N1-60 | GROUNDLEVEL ELEV 750.44 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO.

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION: ~4' EAST OF B1 (N1-80)

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 60.0 | BEDROCK DEPTH: - | TOP OF CASING: 753.17

DATE: START 8/10/83 FINISH 8/10

TIME: START 9:45 am FINISH 12:30 pm

ANNULUS FILL MATERIAL: ABOVE PACKING: CUTTINGS

PACKING: CONCRETE / BENTONITE GROUT

SCREEN: NATURAL MATERIALS

WELL CASING: TYPE AND QUANTITY: (6) 10' SECTIONS OF 2" STAINLESS STEEL SCREEN JOINT (TEFLON TAPED JOINTS)

SCREEN INTERVAL: TYPE AND QUANTITY: (1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

PERSONNEL: L. T. GREETIS, D. D. TOLAN, H. S. ESTES

ELEV.	DESCRIPTION	DEPTH	Sample No.	Sampler Type	Sample Recovery Ft.	Penetrometer (Strength)	N Value (Blows)	REMARKS
	AUGERED DOWN TO 60.0'	10, 20, 30, 40, 50, 60						• NO SAMPLING PERFORMED.
								BORING COMPLETE

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BORING NO B4 | WELL NO N2-60 | GROUNDLEVEL ELEV 749.84 | PAGE 1 OF 1

COUNTY WINNEBAGO | SITE NO

SITE TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION ~0.5 MILE NORTH OF HONONEGAH RD ON WEST SIDE OF 43 51

DRILLING EQUIPMENT CME | SIZE 55 | TYPE HOLLOW STEM AUGER

COMPLETION DEPTH 60.0 | BEDROCK DEPTH – | TOP OF CASING 752.55

DATE: START 8/10/83 | FINISH 8/10

TIME: START 2pm | FINISH 4:20pm

ANNULUS FILL MATERIAL: ABOVE PACKING CUTTINGS

PACKING CONCRETE/BENTONITE GROUT

SCREEN NATURAL MATERIALS

WELL CASING TYPE AND QUANTITY: (6) 10' SECTIONS OF 2" STAINLESS STEEL SCREEN JOINT (TEFLON TAPE JOINTS)

SCREEN INTERVAL TYPE AND QUANTITY: (1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

PERSONNEL
L. T. GREETIS
D. D. TOLAN
H. S. ESTES

SAMPLES

Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)

ELEV.	DESCRIPTION	DEPTH	REMARKS
749.84	AUGERED DOWN TO 60.0' UPPER SAND AND GRAVEL - INCREASE IN GRAVEL SIZE PARTICLES. SAND - fine to coarse sand, tan to brown, finer than at N1-.	10 20 30 40 50 60	• NO SAMPLING PERFORMED. • CLASSIFICATION OF MATERIALS BROUGHT UP WITH AUGER. BORING COMPLETE
689.84			

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LPC 137 6/83

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BORING NO. B5 | WELL NO. N2-50 | GROUNDLEVEL ELEV 749.77 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO.

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION: ~5' SOUTH OF B4 (N2-60)

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 50.0 | BEDROCK DEPTH: — | TOP OF CASING: 752.56

WELL CASING: (5) 10' SECTIONS OF 2" STAINLESS STEEL SCREEN JOINT (TEFLON TAPED JOINTS)

SCREEN INTERVAL: (1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

DATE: START 8/10/83 | FINISH 8/10

TIME: START 4 pm | FINISH 5:45 pm

ANNULUS FILL MATERIAL: ABOVE PACKING: CUTTINGS | PACKING: CONCRETE / BENTONITE GROUT | SCREEN: NATURAL MATERIALS

PERSONNEL: L. T. GREETIS | D. D. TOLAN | H. S. ESTES

ELEV. 749.77 DESCRIPTION	DEPTH	SAMPLES: Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)	REMARKS
AUGERED DOWN TO 50.0'	10, 20, 30, 40, 50						• NO SAMPLING PERFORMED.
							BORING COMPLETE

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BORING NO. B6 | WELL NO. N3-55 | GROUNDLEVEL ELEV 748.75 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO.

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION: ~0.25 MILE NORTH OF HONONEGAH RD ON WEST SIDE OF US 51

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 55.0 | BEDROCK DEPTH: – | TOP OF CASING: 751.68

DATE — START: 8/11/83 | FINISH: 8/11

TIME — START: 7:45 am | FINISH: 9:50 am

ANNULUS FILL MATERIAL — ABOVE PACKING: CUTTINGS

PACKING: CONCRETE/BENTONITE GROUT

SCREEN: NATURAL MATERIALS

WELL CASING TYPE AND QUANTITY:
(5) 10' SECTIONS OF STAINLESS STEEL SCREW JOINT
(1) 5' SECTION OF ABOVE (TEFLON TAPED JOINTS)

SCREEN INTERVAL TYPE AND QUANTITY:
(1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

PERSONNEL
L. T. GREETS
D. D. TOLAN
H. S. ESTES

ELEV. 748.75	DESCRIPTION	DEPTH	Sample No	Sampler Type	Sample Recovery Ft.	Penetrometer (Strength)	N Value (Blows)	REMARKS
	0-2.0' TOPSOIL - SILT, BLACK, DRY.	10						• NO SAMPLING PERFORMED.
	2.0-28.0 SAND & GRAVEL - COARSE sand to very coarse gravel with cobbles.	20						• CLASSIFICATION OF MATERIALS BROUGHT UP WITH AUGER.
	▼	30						Water encountered at 28.0
	28.0-55.0 SAND - tan to brown, angular to subrounded grains, clean, moist.	40						
693.75		50						BORING COMPLETE
		60						

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BORING NO. B7 | WELL NO. N3-40 | GROUNDLEVEL ELEV 748.77 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO.

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION: ~4' SOUTH OF B6 (N3-55)

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 40.0' | BEDROCK DEPTH: — | TOP OF CASING: 751.84

DATE — START: 8/11/83 | FINISH: 8/11

TIME — START: 9:30 am | FINISH: 11:35 am

ANNULUS FILL MATERIAL — ABOVE PACKING: CUTTINGS

PACKING:

SCREEN: NATURAL MATERIALS

WELL CASING: (4) 10' SECTIONS OF 2" STAINLESS STEEL SCREW JOINT (TEFLON TAPED JOINTS)

SCREEN INTERVAL: (1) 2' SCREEN PLUS DRIVE COUPLE + (1) PROTECTIVE COVER

PERSONNEL: L. T. GREETS; D. D. TOLAN; H. S. ESTES

ELEV.	DESCRIPTION	DEPTH	Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)	REMARKS
748.77	AUGERED DOWN TO 40.0'	10, 20, 30, 40						• NO SAMPLING PERFORMED
708.77								BORING COMPLETE

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BORING NO. B8 | WELL NO. N4-60 | GROUNDLEVEL ELEV. 748.21 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO:

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION: NO.3 MILE NORTH OF HONONEGAH RD. ON EAST SIDE OF US 51

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 60.0' | BEDROCK DEPTH: - | TOP OF CASING: 750.91

DATE: START 8/11/83 FINISH 8/11

TIME: START 12:50 pm FINISH 2:40 pm

ANNULUS FILL MATERIAL: ABOVE PACKING: CUTTINGS | PACKING: CONCRETE/BENTONITE GROUT | SCREEN: NATURAL MATERIALS

WELL CASING TYPE AND QUANTITY: (6) 10' SECTIONS OF 2" STAINLESS STEEL SCREW JOINT (TEFLON TAPED JOINTS)

SCREEN INTERVAL TYPE AND QUANTITY: (1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

PERSONNEL: L. T. GREETIS, D. D. TOLAN, H. S. ESTES

SAMPLES

ELEV.	DESCRIPTION	DEPTH	Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)	REMARKS
748.21	0-5.0 Topsoil - SILT - black, dry.							• NO SAMPLING PERFORMED.
	5.0-10.0 SILTY SAND - red to brown - roadbase.	10						
	10.0-28.0 SAND & GRAVEL - tan to brown, coarse sand to very coarse gravel, moist. ▼	20						
		30						• WATER ENCOUNTERED AT 28.0
	28.0-60.0 SAND - tan to brown, fine to coarse grain, angular to sub-rounded grains, wet. finer with depth at 40.0	40						
		50						
688.21		60						BORING COMPLETE

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BORING NO. B9 | WELL NO. N4-50 | GROUNDLEVEL ELEV. 748.36 | PAGE 1 OF 1

COUNTY: WINNEBAGO | SITE NO.

SITE: TCE GROUNDWATER CONTAMINATION - ROSCOE AREA

BORING LOCATION: ~5' NORTH OF B8 (N4-60)

DRILLING EQUIPMENT: CME | SIZE: 55 | TYPE: HOLLOW STEM AUGER

COMPLETION DEPTH: 50.0' | BEDROCK DEPTH: - | TOP OF CASING: 750.88

DATE — START: 8/11/83 | FINISH: 8/11

TIME — START: 2:20pm | FINISH: 4:29pm

ANNULUS FILL MATERIAL — ABOVE PACKING: CUTTINGS

PACKING: CONCRETE / BENTONITE GROUT

SCREEN: NATURAL MATERIALS

WELL CASING — TYPE AND QUANTITY:
(4) 10' SECTIONS OF 2" STAINLESS STEEL SCREEN JOINT
(2) 5' SECTIONS OF ABOVE (TEFLON TAPED JOINTS)

SCREEN INTERVAL — TYPE AND QUANTITY:
(1) 2' SCREEN PLUS DRIVE CONE + (1) PROTECTIVE COVER

PERSONNEL
L. T. GREETIS
D. D. TOLAN
H. S. ESTES

ELEV.	DESCRIPTION	DEPTH	SAMPLES: Sample No.	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blows)	REMARKS
748.36	AUGERED DOWN TO 50.0'	10, 20, 30, 40, 50						• NO SAMPLING PERFORMED.
698.36								BORING COMPLETE

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LPC 137 6/83